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Function Impairment and Pain After Closed Treatment of Fractures of the Mandibular Condyle

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Background: **To determine the prognosis of fractures of the mandibular condyle after closed treatment.**

Methods: **Patients (n = 144) with a fracture of the mandibular condyle, all treated closed, were included in the study. Fracture types and position of the fracture parts were determined on radiographs. Follow-up was after 12 months in which the average pain, experienced during the last week (visual analog scale, 100 mm), and mandibular functioning were assessed (mandibular function impairment questionnaire [MFIQ]).**

Results: **Data of 116 (81%) patients, 41 women (35%) and 75 men (65%), were available for analysis. Condylar neck fractures were most common (52%). Bilateral fractures were present in 28% of the patients. Pain (visual analog scale score >0) was found in 9% of the patients. Impaired mandibular function was found in 40% (MFIQ >0) and 24% (MFIQ ≥4) of the patients. The most important risk factor for pain was being a woman. The most important risk factors for function impairment were ≥25 years of age and gross displacement of the fracture parts.**

Conclusion: **The overall prognosis of mandibular function and pain after closed treatment of condylar fractures is good. The most important risk factor for pain persisting for 1 year after closed treatment of a condylar fracture is being a woman. The most important risk factors for function impairment are an age of ≥25 years and gross displacement of the fracture parts.**

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Fractures of the mandible are the most common of the facial fractures (57%).[1] Fractures of the mandibular condyle represent 34 to 45% of the total number of mandibular fractures and are usually the result of a direct blow to the chin or to the lateral side of the jaw caused by traffic collisions, violence, accidental falls, and sports injuries.[1,2] Many controversies exist as to if, how, and when fractures of the mandibular condyle should be treated.[3] These controversies are based on differences in outcome results of various studies, which can partially be attributed to differences in research design such as case studies or case series,[4–8] retrospective studies,[9–12] and prospective studies.[13–15] Additionally, many different outcome variables have been used such as axiography,[10,16–18] mouth opening,[4,9,19–22] radiographic changes,[8,19,23–25] occlusion,[5,9,11,26] deviations in mouth opening,[9–11] bite force,[27] electromyographic signals,[4,10,11,27] and probably more. Further, many surgeons prefer their personal surgical approach to the fractured condyle (intraoral,[28,29] retromandibular,[30] preauricular,[29] and submandibular[28]). Related to these personal approaches are the personally developed tools and osteosynthesis materials.[12,15,18,28,31–34]

The arguments in favor of one treatment or a specific type of osteosynthesis are usually based on personal experience, preference of the clinic, or the tradition in the country, but the arguments are also based on results of retrospective studies or small prospective studies. Cohort studies in which the effects of treatment are compared between different types of fractures are generally lacking. As a consequence, prognosis is hard to give after fractures of the mandibular condyle are treated closed or by open reduction and fixation. Although many authors claim that they aim at function restoration of the mandible, function is seldom assessed by means of a questionnaire in trauma outcome studies.

The aim of this study was to analyze perceived mandibular function and pain after closed treatment of fractures of the mandibular condyle and to analyze possible risk factors for impaired mandibular function and pain by means of a prospective cohort study.

PATIENTS AND METHODS

Patients

Patients who had been referred to the Department of Oral and Maxillofacial Surgery of the University Medical Center Groningen (Groningen, the Netherlands) during the period between March 1998 and July 2002 with a fracture of the mandibular condyle were asked to participate in this study.

Inclusion criteria were fracture of the mandibular condyle, demonstrated on roentgenograms, i.e. panoramic, Towne projection, transpharyngeal, or transcranial roentgenograms, or compute tomography scanning, and fractures of less than 1 week old. Exclusion criteria were a history of

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psychiatric disorders or mental retardation, the inability to understand Dutch, and impairments in mandibular function or pain in the mandibular locomotor system before fracturing the mandibular condyle.

Fracture Assessment

Fracture types and the posttraumatic position of the fracture segments were assessed by roentgenogram by a senior staff member of the department (R.R.M.B.). The fracture types that were distinguished included intracapsular fractures, fractures of the neck of the condyle, and subcondylar fractures.[3] The latter two types of fractures are extracapsular. In subcondylar fractures, the fracture line runs below the level of the mandibular notch. In condylar neck fractures, the fracture line runs through or above the mandibular notch. Intracapsular fractures are those in which the fracture line lies within the capsule of the temporomandibular joint. Additional fractures of the mandible or the maxilla were recorded.

The positions of the fracture segments that were distinguished included dislocation of the condylar head (yes or no), displacement (gross, none, or minor displacement), and deviation (yes or no). The condyle was considered to be dislocated if the condylar head was in front of the articular eminence or if the proximal segment made an angle of approximately 50 degrees or more, medially or laterally, relative to the distal segment. The fracture segments were considered displaced when the proximal segment of the fracture was displaced relative to the distal segment and no overlap between the two segments was present. The displacement was assessed as grossly displaced, not displaced, or minor displacement. The fracture segments were considered deviated if the proximal segment and the distal segment made contact and there was angulation between the segments.

Treatment

Treatment of fractures of the mandibular condyle was performed according to the standard procedures of the Department of Oral and Maxillofacial Surgery of the University Medical Center Groningen, the Netherlands. The following treatment principles were applied.

If occlusion was normal or only minimally disturbed, no treatment was given. Standard follow-up appointments were made at 1 week, 3 weeks, 6 weeks, and 12 weeks after trauma. The patient was instructed to contact the department if complaints increased or if occlusion deteriorated. Depending on complaints and stability of occlusion, follow-up appointments were made less of more frequent.

If an open bite was present of 1 to 1.5 mm but the patient could reach maximal occlusion, when asked for, the treatment was as described above.

If occlusion deteriorated and the patient could not reach maximal occlusion, arch bars were inserted, and guiding elastics were given for a period of 2 to 3 weeks, depending on the ability to reach maximal occlusion. Gradually the number of elastics would be reduced. Usually, within 1 week the number of elastics was reduced to two or three. After 6 weeks, the arch bars were removed. If the posttraumatic open bite was more than 1.5 mm, standard arch bars were inserted, and guiding elastics were given.

Bilateral condylar fractures were always treated with arch bars and guiding elastics unless no occlusal disturbances were present. On no occasion, rigid intermaxillary fixation was used.

During the first 3 weeks of recovery, a soft food diet was advised for all patients. After the soft food diet, a gradual increase in consistency of food was allowed, depending on complaints. Additionally, the oral and maxillofacial surgeon advised and stimulated the patient to perform gentle range-of-motion exercises, vertically and horizontally, to improve

Table 1 Fracture and Accident Characteristics in 116 Subjects

Fracture Characteristics*	% (n)
Intracapsular	22 (25)
Extracapsular	
Condylar neck	52 (60)
Subcondylar	32 (37)
Bilateral condylar fractures	28 (32)
Position of fracture parts	
Deviation	21 (24)
Displacement of fracture	56 (65)
Minor displacement	22 (26)
Gross displacement	34 (39)
Dislocation of the condyle	19 (22)
Number of additional mandibular fractures	
1	45 (52)
2	5 (6)
3	3 (3)
Accident characteristics	
Traffic accidents	57 (66)
Accidental falls	24 (28)
Violence	11 (13)
Other causes	8 (9)
Drug or alcohol consumption before the accident	37 (43)

* Because of rounding of values and because some patients had a condylar as well as subcondylar fractures, the total percentage is more than 100%.

Table 2 Descriptive of the Outcome Variables

Outcome Variables	Mean (SD)
Follow-up (y)	1.2 (0.7)
VAS pain (mm)	2.3 (9.3)
MFIQ	3.4 (7.3)
Outcome variables dichotomized (%[n])	
Age (25 y or older)	47 (55)
Pain at follow-up (VAS pain >0)	9 (10)
Function impairment at follow-up	
MFIQ > 0	40 (46)
MFIQ ≥ 4	24 (27)
Follow-up less than 1 year	27 (31)

maximal interincisal distance and translatory movements of the affected condyle. If the improvement in range of motion was insufficient, physical therapy was prescribed.

Fractures of other parts of the mandible were treated according to the principles of open reduction using internal fixation with screws and plates (2.0–2.3 mm Martin system; Martin GmbH, Germany).

Follow-Up

For this study, patients were assessed on T0 (immediately after trauma) and were also invited to visit our department after 6 and 12 months for follow-up. If the patients failed to meet the appointment, a new invitation was sent. If the patients had not responded after 2 weeks, a reminder was sent. No further action was undertaken to contact the patients if they did not respond after the reminder.

During their first visit to the department, patients were asked whether they had experienced pain, restricted mouth opening, joint sounds, or occlusal problems before the accident and, if so, whether these problems had impeded mandibular functioning. If the patients had experienced restrictions in mandibular functioning before the accident, they were excluded from the study.

Assessments

During follow-up, the average pain experienced during the last week was assessed by means of a visual analog scale (VAS) of 100 mm. Mandibular functioning was assessed by means of the mandibular function impairment questionnaire (MFIQ).[35] The MFIQ is a questionnaire assessing, on a 5-point Likert scale, perceived hindrance during 11 mandibular functions and perceived difficulty eating food with different consistencies collected in six items (scale range, 0–68).[35] For this study, the assessments at 12 months after trauma were analyzed. If the patient had failed this appointment, the assessment of 6 months after trauma was used. If the patient had also failed that appointment, the data of that patient were excluded from the analyses. Thus, the minimal follow-up was 6 months. All participants gave oral and written consent. If the patients were younger than the age of 18, parents or care takers gave oral and written consent. This study was approved by the medical ethical review board of the University Medical Center Groningen.

Statistical Analysis

Two cutoff points of impaired mandibular function were used, i.e. an MFIQ score higher than 0 and of 4 or more, respectively. Pain after fracture was defined as any score >0 on the VAS. Statistics were performed in SPSS for Windows (SPSS, Chicago, Ill) and included descriptive statistics and χ^2 analysis to identify possible risk factors for an impaired mandibular function and pain. As potential risk factors for an impaired mandibular function and pain, fracture characteristics, cause of the fracture, sex, age, and duration of follow-up were analyzed. Factors that were significantly related to impaired mandibular function and pain were entered in a multivariate logistic regression analysis. This type of analysis is to determine the relationship between two or more continuous or categorical explanatory variables and a single dichotomous outcome variable. In this study, the outcome variable was the chance of developing restricted mandibular function or pain, and the explanatory variables were the risk factors such as location of the fracture and amount of displacement.

For all statistical tests, a significance level of 0.05 was used.

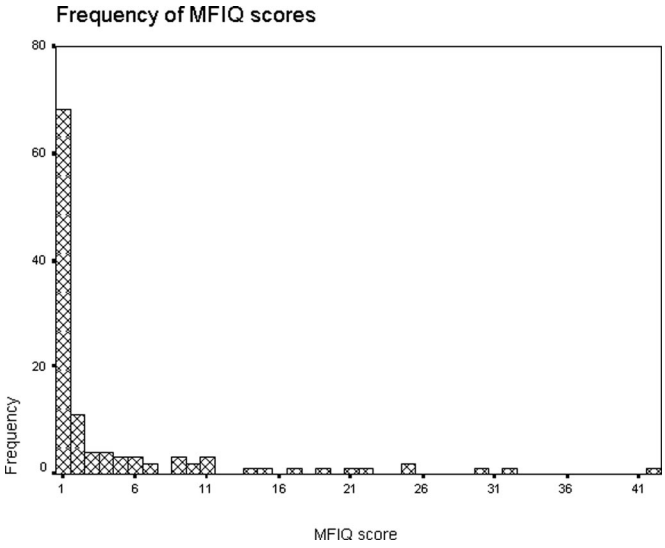

Fig. 1. *Frequency distribution of the scores on the MFIQ.*

RESULTS

In total, 144 patients with fractures of the mandibular condyle were initially included in this study. Of 119 patients with follow-up data, 28 had a follow-up of 6 months, and 91

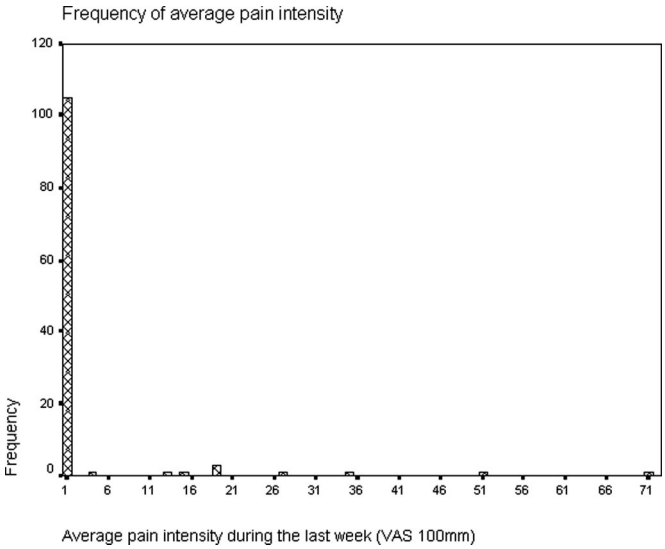

Fig. 2. *Frequency distribution of average pain intensity during the last weak assessed on a VAS.*

Table 3 Risk Factors for Mandibular Function Impairment (Two Cutoff Scores) and Pain

Risk Factors	MFIQ > 0%	*p*	MFIQ ≥ 4%	*p*	VAS pain >0%	*p**
Sex		0.829		0.293		0.018
Women	39.0		29.3		17.1	
Men	41.1		20.5		4.1	
Age 25 y or older		0.006		0.022		0.142
Yes	53.7		33.3		12.7	
No	28.3		15.0		5.0	
Alcohol or drug consumption		0.046		0.574		0.695
Yes	32.4		26.7		6.7	
No	51.1		22.1		8.7	
Traffic accident		0.597		0.869		0.861
Yes	42.4		24.2		9.1	
No	37.5		22.9		8.2	
Follow-up less than 1 y		0.698		0.654		0.820
Yes	39.3		22.6		8.7	
No	43.4		26.7		9.7	
Type of condylar fracture		0.023		0.007		0.023
Intracapsular	60.0		44.0		20.0	
Extracapsular	34.8		18.0		5.6	
Extracapsular fractures		0.006		0.021		1.000
Condylar neck	55.6		33.3		8.3	
Subcondylar	27.1		13.6		8.3	
Bilateral of mandibular head or neck		0.970		0.836		0.872
Yes	40.6		25.0		9.4	
No	40.2		23.2		8.4	
Displacement of fracture parts		0.022		0.049		0.991
Gross displacement	54.8		35.7		9.5	
No or minor displacement	32.9		19.2		9.5	
Dislocation of TMJ		0.141		0.331		0.435
Yes	54.5		31.8		4.5	
No	37.5		22.2		9.8	
Deviation of fracture parts		0.749		0.712		0.376
Yes	37.5		20.8		4.2	
No	41.1		24.4		9.9	
Additional mandibular fractures		0.284		0.668		0.420
Yes	35.6		22.0		6.7	
No	45.5		25.5		10.9	
Pain VAS >0		0.007		<0.001		
Yes	80.0		70.0			
No	36.5		19.2			
Extracapsular fractures†		0.052		0.123		0.537
Gross displacement	35.7		31.0		6.9	
No or minor displacement	19.2		16.9		9.1	

TMJ, temporomandibular joint.

* Significance of $\chi 2$ analysis.

† Because fractures of the condylar neck and subcondylar fractures with gross displacement are considered as risk factor for poor function, these fractures were analyzed separately.

had a follow-up of 1 year or more. The average follow-up was 1.2 years (SD, 0.7). Two patients were excluded because they received open reduction because of comminuted multiple mandibular fractures. Another patient was excluded because of function impairment before trauma. Thus, the data of 116 patients (81%), 35% woman (n = 41) and 65% men (n = 75), were available for analyses. The mean age was 27.8 years (SD, 13.7). Of the dropouts, 21% were women (n = 6) and 79% were men (n = 22), with a mean age of 37.7 years (SD, 15.0). The age difference between participants and dropouts was significant ($p < 0.05$).

Fracture and accident characteristics are summarized in Table 1. Fractures of the condylar neck were most common. Bilateral fractures were present in 28% of the patients.

In 53% of the patients, additional fractures of the mandible were present. The most common cause of the fractures was a traffic accident. Drug or alcohol consumption before the accident was reported by 37% of the patients.

The main outcome variables are presented in Table 2. Because the data were positively skewed (Figs. 1 and 2), they were dichotomized according to the cutoff scores presented in Table 2.

Table 4 Results of the Logistic Regression Analysis With Mandibular Function Impairment as a Dependent Variable

Dependent	Independent	ß	OR (exponent ß)	95% CI
All fractures of the mandibular condyle				
Function impairment >0				
	≥25 y†	1.1	3.1	1.4–7.0
	Gross displacement‡	1.0	2.8	1.2–6.3
	Constant	−1.4	0.3	
Function impairment ≥4				
	≥25 y†	1.0	2.7	1.1–6.5
	Constant	−1.6	0.2	
Pain >0				
	Sex (men)§	−1.5	0.2	0.05–0.9
	Intracapsular fracture‖	1.4	3.9	1.0–15.3
	Constant	−2.1	0.1	
Extracapsular fractures only*				
Function impairment >0				
	≥25 y†	1.2	3.3	1.3–8.5
	Fractures of the condylar neck¶	1.4	4.0	1.6–10.4
	Constant	−1.7	0.2	
Function impairment ≥4				
	≥25 y†	1.7	5.7	1.7–18.6
	Fractures of the condylar neck¶	1.5	4.5	1.4–13.6
	Constant	−3.0	0.05	

OR, odds ratio; CI, confidence interval.

* Because fractures of the condylar neck and subcondylar fractures with gross displacement are considered as a risk factor for poor function, these fractures were analyzed separately.

† Compared with patients with age <25 years; ‡ compared with fractures with no or minor displacement; § compared with women; ‖compared with extracapsular fractures, ¶ compared with subcondylar fractures.

The different risk factors and their associations with function impairment and pain are presented in Table 3. The results of the logistic regression analysis (Table 4) were used to calculate the chance (risk) of developing function impairment or pain after fracturing the mandibular condyle (Tables 5, 6, and 7).

DISCUSSION

The prognosis of mandibular function after closed treatment of condylar fractures is good. The mean function impairment was 3.4 (SD, 7.3) on a scale range of 68 points, and the mean pain intensity assessed on a VAS (100 mm) was 2.3 (SD, 9.3). Because the data were highly skewed (Figs. 1 and 2), the data were dichotomized as described. The overall chance of developing function impairment (MFIQ >0) was 40%, and the overall chance of developing function impairment (MFIQ ≥4) was 24%. These percentages do not seem favorable at first glance. However, it should be remembered that the average scores of function impairment and pain were very low. A minority of patients had high scores on function

Table 5 Chance of Developing Restriction in Mandibular Function (MFIQ score >0 or MFIQ score ≥4)

	MFIQ Score >0		
	No or Minor Displacement	Gross Displacement	MFIQ Score ≥4
Younger than 25 y	0.21	0.42	0.17
25 y or older	0.45	0.69	0.35

Chances are calculated on the basis of the logistic regression analyses (Table 4).

Table 6 Chance of Developing Restriction in Mandibular Function (MFIQ score >0 or MFIQ score ≥4) for Extracapsular Fractures Only

	MFIQ Score>0		MFIQ Score≥4	
Mandibular Fracture	Condylar Neck	Subcondylar	Condylar Neck	Subcondylar
Younger than 25 y	0.43	0.16	0.19	0.05
25 y or older	0.72	0.39	0.56	0.23

Chances are calculated on the basis of the logistic regression analysis (Table 4).

Table 7 Chance of Developing Pain After a Fracture of the Mandibular Condyle (VAS pain >0)

Mandibular Fracture	Man	Woman
Intracapsular	0.10	0.33
Extra capsular	0.03	0.11

Chances are calculated on the basis of the logistic regression analysis (Table 4).

impairment and pain. The relevance of our outcome in function impairment after fractures of the mandibular condyle cannot be assessed easily because no epidemiologic data or data after condylar fractures are available for comparison. In the multivariate analysis, the most important risk factors for function impairment were age ≥25 years (both cutoff points) and gross displacement of the fracture segments (cutoff point, ≥4).

It can be hypothesized that open reduction might be the treatment option if these risk factors are present to reduce the risk for function impairment. However, no randomized clinical trials exist to substantiate this hypothesis.

Patients with function impairment before the accident were excluded from the study. Therefore, all patients included in the study were ″at risk″ for developing mandibular function impairment as a result of the accident. Without formally controlling for it, we have the impression that at least a part of the impairments assessed by means of the MFIQ was caused by dental trauma, such as painful teeth while biting and chewing and hypersensitivity of teeth to warmth and cold. Furthermore, some patients explained that they were afraid to load restored teeth during biting and chewing because they feared damage to their teeth again.

The overall chance of perceiving pain was 9%, indicating that 9% of the patients after closed treatment of condylar fractures experience chronic pain. This percentage is similar to that found by Hyde et al.[33] of 6% (2 of 32 patients). However, in that study, compliance to follow-up of their patients treated with open reduction was 76% (25 of 33), whereas the compliance of their patients treated closed was only 33% (7 of 21). In our study, the compliance to the protocol was 83%.

From the univariate analyses, it appeared that risk factors for function impairment (cutoff point, >0) were age, alcohol or drug consumption, intracapsular fractures, condylar neck fractures, gross displacement, and pain. Risk factors for function impairment (cutoff point, ≥4) were intracapsular fractures, condylar neck fractures, and pain. Risk factors for experiencing pain were sex and intracapsular fractures. In the multivariate logistic regression analysis, several of the factors, identified as risk factors for function impairment in univariate analyses, were no longer significant. The risk factors for function impairment and pain differed (Table 3). Patients with an age of 25 or older apparently have a higher risk of developing chronic pain, and women have a higher risk of developing chronic pain compared with men.

Similar to the discussion of reducing the risk for function impairment, it can be hypothesized that women with intracapsular fractures should be treated with open reduction to reduce the risk for pain, but again, no randomized clinical trials exist to substantiate this hypothesis.

As mentioned before, large prospective studies analyzing prognosis of condylar fractures are scarce. In a prospective evaluation of 348 patients with condylar fractures treated closed, complaints after 1 year were evaluated.[14] Thirteen percent of the patients reported complaints, including reduction of mouth opening or deviation during mouth opening, malocclusion, or clicking sounds of the joint. Only 3% of these patients reported pain. However, it is not clear how these complaints were exactly assessed and which instruments were used. Mandibular function was not assessed in that study. Similar to our study, no association was found between bilateral fractures and the presence of complaints. Also Newman[36] found no pain complaints after bilateral condylar fractures.

In conclusion, the overall prognosis of mandibular function and pain after closed treatment of condylar fractures is good. The most important risk factor for pain persisting for 1 year after closed treatment of a condylar fracture is being a woman. The most important risk factors for function impairment are an age of ≥25 years and gross displacement of the fracture parts.

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